



Agilent Technologies

V281C/D and W281C/D 1.0 mm Coaxial to Waveguide Adapters

Operating and Service Manual



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General Information

1.0 mm Connector Overview

These adapters are used for the measurement of components with 50Ω , 1.0 mm connectors with a frequency range from DC to 110 GHz.

The 1.0 mm connector utilizes an air dielectric interface for the highest accuracy and repeatability. The coupling diameter and thread size were chosen to maximize strength, increase durability and provide highly repeatable connections. The connectors are designed so that the outer conductors engage before the center conductors.

To obtain the best performance possible, the manufacturing tolerances of the connectors are tighter than the standard 1.0 mm specifications per the IEEE 287 connector standard.

About This Manual

This manual describes the V281C/D and W281C/D coaxial to waveguide adapters and provides replacement part numbers, specifications, and procedures for using and maintaining the adapters.

Throughout this manual, the V281C/D and W281C/D coaxial to waveguide adapters will be referred to as the V and W-band Adapters.

Serial Numbers

A serial number label is attached to each adapter. The serial number is made up of five numbers and is unique to each adapter.

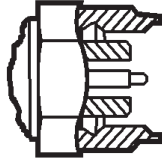
Incoming Inspection

Agilent Technologies will arrange for repair or replacement of incomplete or damaged shipments without waiting for a settlement from the transportation company. When you send a device to Agilent Technologies, include the following information:

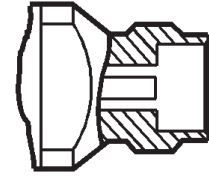
- Your company name and address.
- A technical contact person within your company, and the person's complete phone number.
- If you are returning one or more devices, include the part numbers and serial numbers.
- Indicate the type of service required.
- Include any applicable information.

Clarifying Connector Sex

In this manual, connectors are referred to in terms of their device sex



Male Connector



Female Connector

Figure 1-1 *Male and Female Connectors*

Preventive Maintenance

The best techniques for maintaining the integrity of these adapters is to include routine visual inspection (using 10X magnification), cleaning and proper connection techniques. Failure to detect and remove dirt or metallic particles on a mating plane surface can degrade repeatability and accuracy, and can damage any connector mated to it. Improper connections resulting from poor connection techniques can also damage these devices.

Visual inspection, cleaning techniques, and connection techniques are all described in [Chapter 3, "Making Connections"](#).

Specifications

Environmental Requirements

Table 2-1 Environmental Requirements

Parameter	Required Values/Ranges
Operating Temperature	0° to 55°C (32° to 131° F)
Storage Temperature	−40° to +75°C (−40° to +167° F)
Altitude	
Operation	< 15,000 meters (≈ 50,000 feet)
Storage	< 15,000 meters (≈ 50,000 feet)
Relative Humidity	Always Non-Condensing
Operation	0 to 80% (26° C maximum dry bulb)
Storage	0 to 90%

Temperature—What To Watch Out For

Due to the critical dimensions and tight tolerances of the 1.0 mm connectors on your adapters, electrical characteristics will change with temperature. The operating temperature is a critical factor in the performance during measurements and between calibrations.

NOTE

Remember your fingers are a heat source, so avoid handling the devices unnecessarily during calibration.

Electrical Specifications

V281C and V281D	Frequency Range	50 to 75 GHz
	Return Loss (at coaxial port only)	–16 dB max
W281C and W281D	Frequency Range	75 to 110 GHz
	Return Loss (at coaxial port only)	–16 dB max

Mechanical Characteristics

Center Conductor Protrusion and Pin Depth	Mechanical characteristics such as center conductor protrusion and pin depth are <i>not</i> performance specifications. They are important supplemental characteristics related to electrical performance. Agilent Technologies verifies the mechanical characteristics of the V and W-band adapters with special gaging processes and electrical testing. This ensures that the adapter connectors do not exhibit any center conductor protrusion and have proper pin depth when they leave the factory.
Supplemental Mechanical Characteristics	Supplemental mechanical characteristics are values which are typically met by the majority of the adapters tested at Hewlett–Packard. These supplemental characteristics are intended to provide useful information. These are typical but non-warranted performance parameters. The following table lists the typical mechanical characteristics of the 1.0 mm connectors in the V and W-band adapters.

Table 2-2 Typical 1.0 mm Connector Characteristics

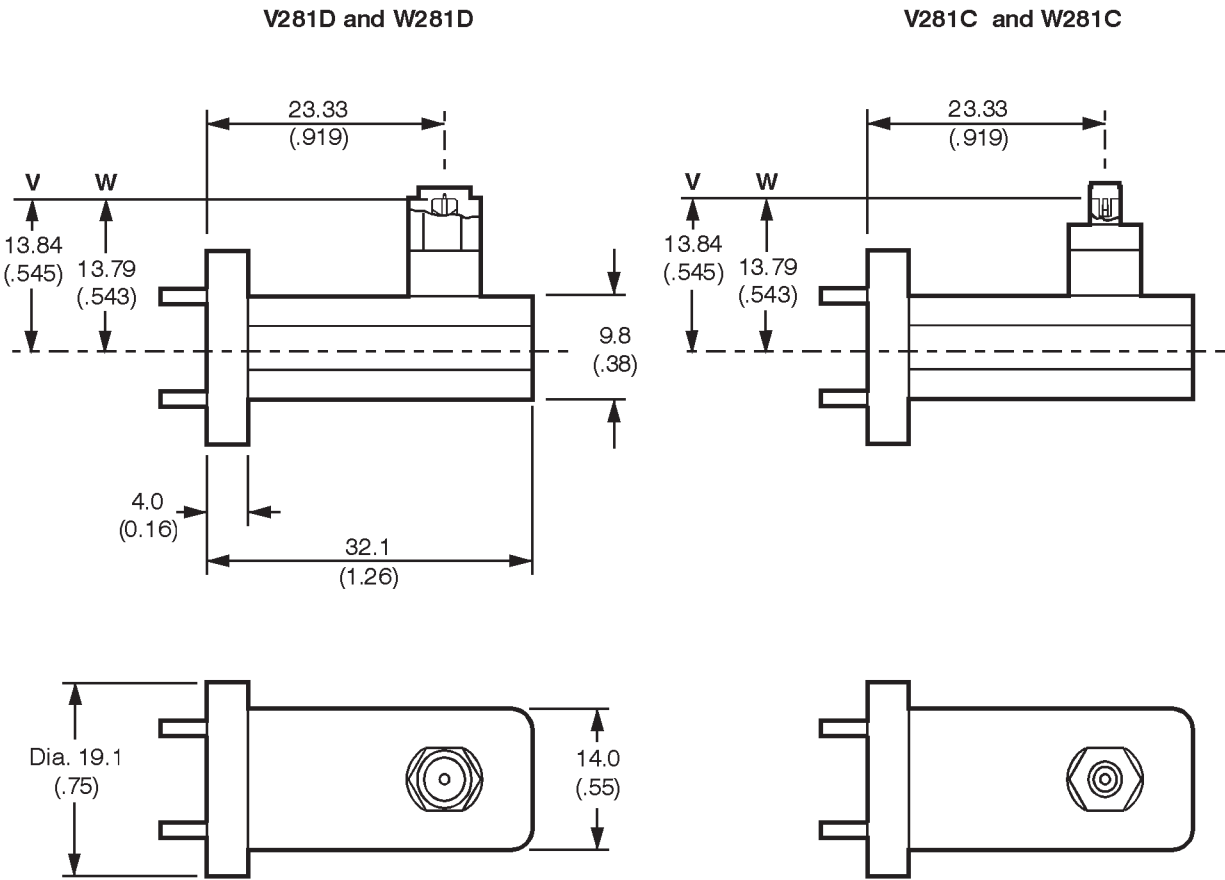
Characteristic	Typical Value
Inside Diameter of Outer Conductor	1.000 ± 0.005 mm
Outside Diameter of Center Conductor	0.434 ± 0.005 mm
Pin Depth	0 (flush) to 0.020 mm (maximum recession)
Flatness of Reference Plane	0.005 mm (worst case)

Table 2-3 Supplemental Characteristics

	V281C/D	W281C/D
Maximum Power:		
@ 75, 110 GHz	12W	12W
Ambient	25 degrees	25 degrees
Net Weight		
	0.1 kg	0.1 kg
	0.2 lbs	0.2 lbs
Waveguide Designator:		
EIA	WR-15	WR-10
MIL-W-85	3-018	3-024
Flange Designator:		
UG - () / U	385	387
MIL - F - 3922 / ()	67B - 002	67B - 010
Insertion Loss	-0.8 dB max	-1.0 dB max
Repeatability ¹	-45 dB max	-40 dB max

1. Repeatability = $20 \log \frac{1}{\Delta \Gamma}$ where $\Gamma = \Gamma_{m1} - \Gamma_{m2}$. This is the difference between two measurements Γ_{m1} and Γ_{m2} before and after one disconnect/connect cycle at the coax port. Repeatability depends upon proper torque and pin depth.

Mechanical Dimensions



vw281cd

Figure 2-1 V281C/D and W281C/D Dimensions

Making Connections

Electrostatic Discharge

Protection against ESD (electrostatic discharge) is essential while cleaning, inspecting, or connecting any connector attached to a static-sensitive circuit (such as those found in test sets).

Static electricity builds up on the body, and can easily damage sensitive internal circuit elements when discharged by contact with the center conductor of a connector. Static discharges too small to be felt can cause permanent damage. Devices such as calibration and verification components, and devices under test can also carry an electrostatic charge.

- Always have a grounded antistatic mat in front of your test equipment and wear a grounded wrist strap attached to it.
- Ground yourself before you clean, inspect, or make a connection to a static-sensitive device or test port. You can, for example, grasp the grounded outer shell of the test port briefly to discharge static from your body.
- Discharge static electricity from a device before connecting it: touch the device briefly (through a resistor of at least 1 M Ω) to either the outer shell of the test port, or to another exposed ground. This discharges static electricity and protects test equipment circuitry.

Supplies and Equipment Required but Not Supplied

Various connector cleaning supplies and electrostatic discharge safety supplies are *not* provided in this kit. For cleaning and inspection, a 10X magnifying glass is available (Refer to [Chapter 4, “Replaceable Parts”](#) for ordering information.)

Visual Inspection

Visual inspection, and if necessary, cleaning should be done every time a connection is made. Metal particles from the connector threads may fall into the connector when it is disconnected. One connection made with a dirty or damaged connector can damage both connectors beyond repair.

Required Inspection Tools

Magnification is helpful when inspecting connectors, but it is not required and may actually be misleading. Defects and damage that cannot be seen without magnification generally have no effect on electrical or mechanical performance. Magnification is of great use in analyzing the nature and cause of damage and in cleaning connectors, but it is not required for inspection.

Obvious Defects or Damage

Examine the connectors first for obvious defects or damage:

- Plating
 - ▲ Bare metal showing
 - ▲ Burrs or blisters
- Deformed threads
- Center Conductors
 - ▲ Bent
 - ▲ Broken
 - ▲ Misaligned
 - ▲ Concentricity

Connector nuts should move smoothly and be free of:

- Burrs
- Loose metal particles
- Rough spots

Any connector that has obvious defects should be discarded. See [Figure 3-1](#), [Figure 3-2](#), and [Figure 3-3](#) for visual inspection guidelines.

Connector Contacts

A minimum magnification of 10X is required to inspect the connector contacts. You must also use a magnifying glass to inspect for contact integrity. It is necessary to use good lighting (such as a halogen task light) to see the contacts.

NOTE

Notice the location of the cross hairs in relationship to the center of the following figures.

See [Figure 3-1](#) for visual guidelines when evaluating the contact integrity of a connector.

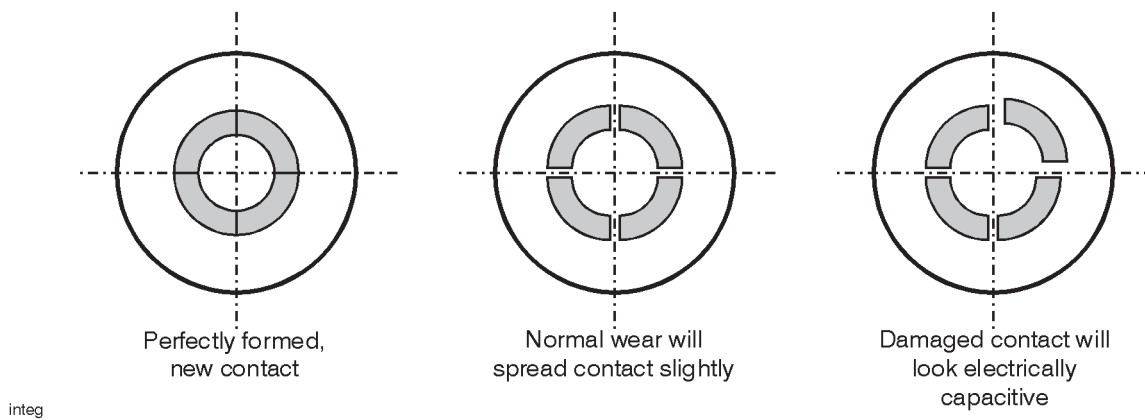


Figure 3-1 Contact Integrity

Concentricity

[Figure 3-2](#) and [Figure 3-3](#) show the concentricity of both the male and female 1.0 mm connectors.

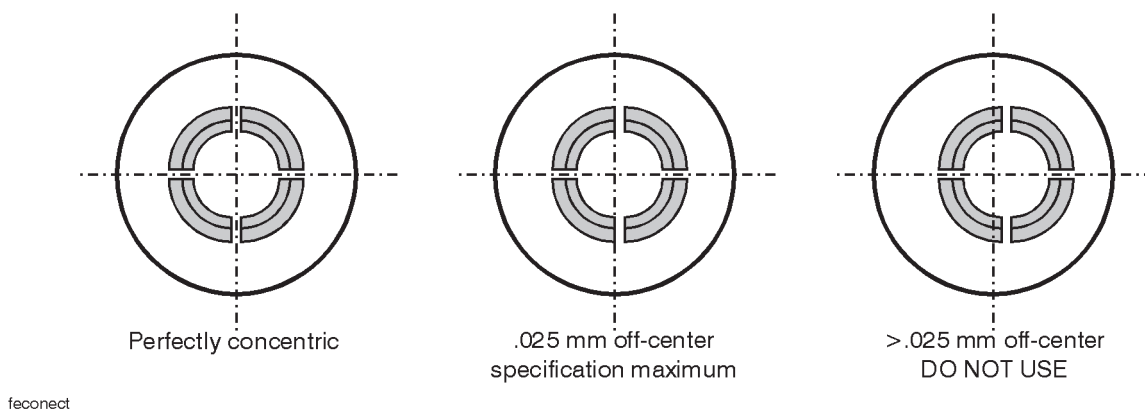


Figure 3-2 Concentricity - Female Connector

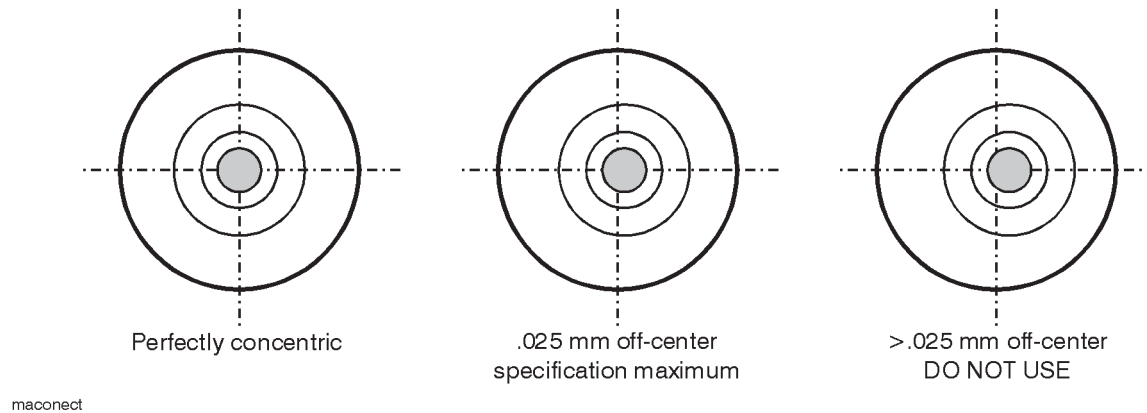


Figure 3-3 Concentricity - Male Connector

Mating Plane Surfaces

Flat contact between the connectors at all points on their mating plane surface is required for a good connections.

Look for deep scratches or dents, and for dirt and metal particles on the connector mating plane surfaces. Also look for “dings” on the mating plane surfaces of the center and outer conductors, and for signs of damage due to misalignment and excessive or uneven wear.

A light burnishing of the mating plane surface is normal. This is evident as light scratches, or shallow circular marks distributed more or less uniformly over the mating plane surface. Other small defects and cosmetic imperfections are also normal. None of these affect electrical or mechanical performance.

Clean and inspect the connector again if it shows:

- Deep scratches or dents
- Particles clinging to the mating plane surface
- Uneven wear

Damaged Connectors

If you find a damaged connector, try to determine the cause of the damage *before* connecting a new, undamaged connector in the same configuration. Damaged connectors should be discarded.

Connector Wear

Connector wear eventually degrades performance. The more use a connector gets, the faster it wears and degrades. The wear is greatly accelerated when connectors are not kept clean. When your connectors become worn, replace them.

Pin Depth

Pin depth is the distance that the center conductor mating plane differs from being flush with the outer conductor mating plane. The pin depth of a connector can be in one of two states, either protruding or recessed.

Protrusion and Recession

- **Protrusion** - the center conductor *extends* beyond the outer conductor mating plane.

NOTE

At *no* time should the pin depth of the 1.0 mm connector be protruding.

- **Recession** - the center conductor is *set back* from the outer conductor mating plane.

The pin depth value of each adapter was verified to be within factory specifications at shipment. The electrical performance of the adapter depends, to some extent, on its pin depth. The electrical specifications for each adapter takes into account the effect of pin depth on the adapters performance. See [Figure 3-4](#) for a visual representation of proper pin depth (slightly recessed).

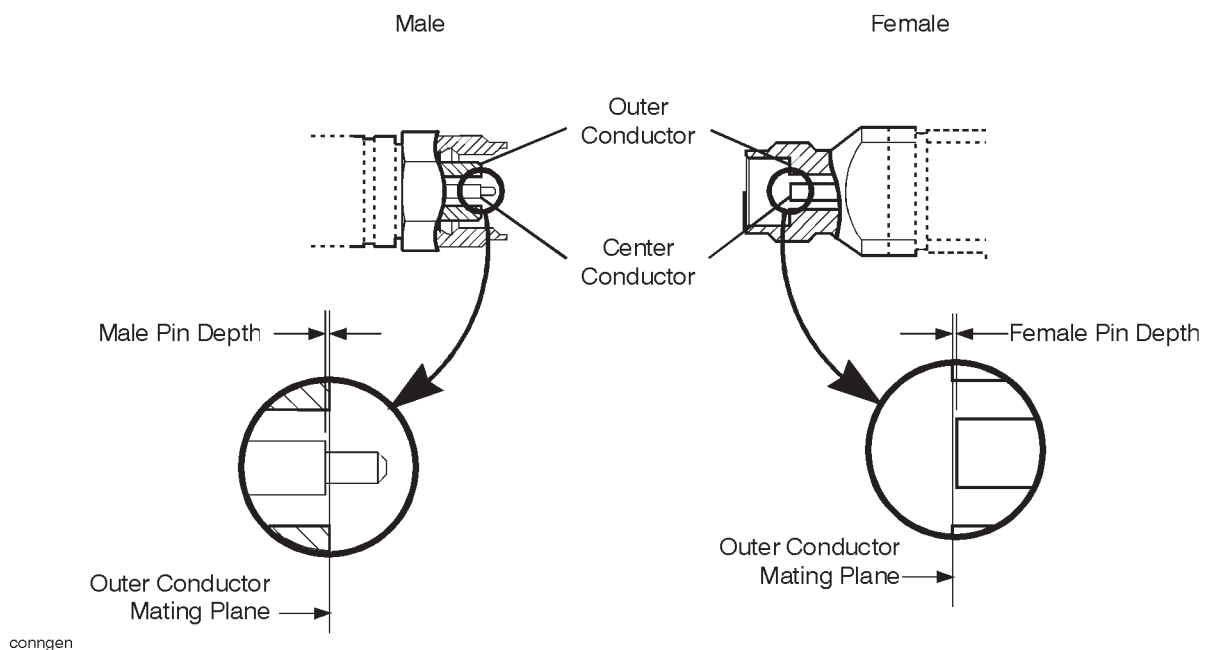


Figure 3-4 Connector Pin Depth

Making Connections

Good connections require a skilled operator. Instrument sensitivity and coaxial connector mechanical tolerances are such that slight errors in operator technique can have a significant effect on measurements and measurement uncertainties.

NOTE

The most common cause of measurement error is poor connections.

Follow these recommendations for optimum connection technique:

1. Clean and inspect (visually and mechanically) all of your connectors.
2. Align connectors carefully. Look for flat physical contact at all points on the mating plane surfaces.

1.0 mm Connector Alignment

If one of the 1.0 mm connectors is free to move, this will make it possible for the connectors to self-align during connection. Self-alignment occurs because outer conductors engage before the center conductors (see [Figure 3-5](#) and [Figure 3-6](#)).

1. Make a gentle, preliminary connection.
2. When making a connection, turn *only* the connector nut. Do not rotate a device when you make a connection, and do not apply a lateral or horizontal (bending) force.
3. Use an open-end wrench to keep the device from rotating when you make a final connection with the torque wrench (see [Table 4-1 on page 4-1](#) for ordering information).

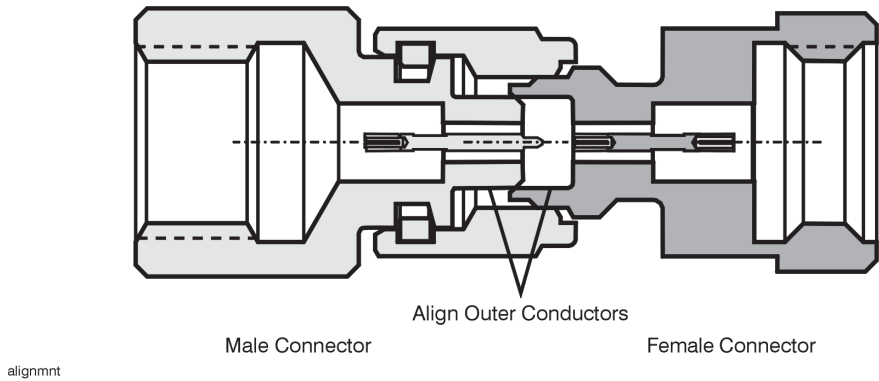


Figure 3-5 Alignment

1.0 mm Connector
Misalignment

Forced misalignment could damage the female center conductor.

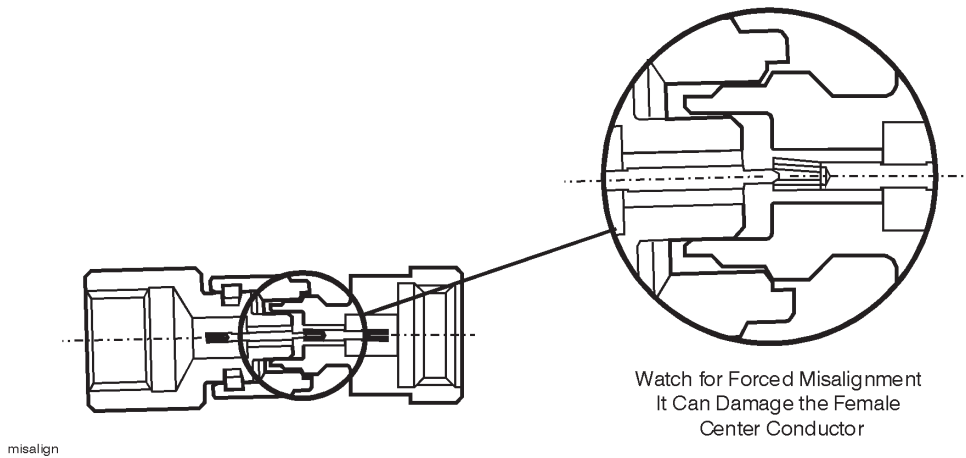


Figure 3-6 Forced Misalignment

NOTE To achieve misalignment as shown in [Figure 3-6](#) you must use *excessive* force.

Cleaning Connectors

Supplies and Equipment Needed

The supplies and equipment that are needed to perform the cleaning procedures, and their Agilent Technologies part numbers are listed in [Table 4-1](#).

NOTE

A minimum magnification of 10X is required for all inspections of the adapter parts.

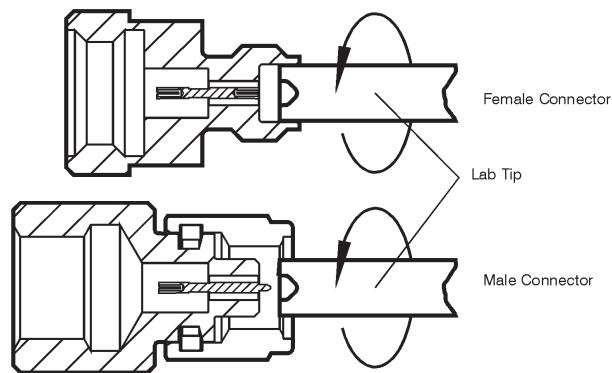
Basic Cleaning Procedure

1. Inspect the connectors for dust, dirt, metal fragments, oils or films, and debris.
2. Blow off any dust with a filtered, clean supply of compressed air.
3. Add a few drops of high-purity isopropyl alcohol to small cleaning swab (do not apply alcohol directly to the parts).

NOTE

When using isopropyl alcohol to clean connectors *do not* allow liquid to flow down inside the connector. This may cause measurement errors due to residue inside the connector. If possible keep the connector facing down.

4. *Gently* wipe connecting surfaces with the end of the cleaning swab (see [Figure 3-7](#)).
5. Blow dry with a clean supply of compressed air.
6. Inspect and repeat cleaning procedure if necessary.



cleaning

Figure 3-7 Cleaning Illustration

Making a Connection

Connection Procedure

1. Ground yourself and all devices (wear a grounded wrist strap and work on an antistatic mat).
2. Visually inspect the connectors (refer to [“Visual Inspection” on page 3-2](#)).
3. If necessary, clean the connectors (refer to [“Cleaning Connectors” on page 3-8](#)).
4. Carefully align the connectors. The male connector center pin must slip concentrically into the contact fingers of the female connector (see [Figure 3-5](#) and [Figure 3-6](#)).
5. Push the connectors straight together. Do *not* twist or screw them together. As the center conductors mate, there is usually a slight resistance.

CAUTION

Do *not* twist one connector into the other (like inserting a light bulb). This happens when you turn the device body, rather than the connector nut. Major *damage* to the center conductor and the outer conductor can occur if the device body is twisted.

6. Initial tightening can be done by hand, or with a 6 mm open-end wrench. Tighten until “snug” or where the connectors are first making contact. The preliminary connection is tight enough when the mating plane surfaces make uniform, light contact. *Do not overtighten* this connection.

At this point, all you want is for the outer conductors to make gentle contact on both mating surfaces. Use very light finger pressure (no more than 2 in-lbs of torque).

7. Relieve any side pressure on the connection from long or heavy devices or cables. This assures consistent torque (refer to [“Using the Torque Wrench”](#)).

Connecting Waveguides

The waveguide mating planes are precision flanges that you must *carefully* screw together. Flat contact between the connectors at *all* points on their mating plane surface is required for a good connection. Inspect the mating surfaces for any gaps, or any condition that will not allow the surfaces to lay flat. *Always* connect waveguide in the same flange orientation using an X pattern (for equal compression).

Using the Torque Wrench

Table 3-1 provides information on the torque wrench required for the connector type of your adapter.

Table 3-1 Torque Wrench Information

Connector Type	Torque Setting	Torque Tolerance
1.0 mm	45 N-cm (4 in-lb)	5.4 N-cm (± 0.5 in-lb)

Torque Wrench Procedure

Using the torque wrench guarantees that a connection is not too tight. This will help prevent possible connector damage. It also guarantees that all connections are equally tight each time.

Do not pre-tighten so much that there is no rotation of the nut with the torque wrench. Static friction must *not* be present during torquing.

Rotate *only* the connector nut when you tighten the connector. In *all* situations, the use of an open-end wrench to keep the body of the device from turning is recommended.

Disconnection Procedure

To avoid lateral (bending) force on the connector mating plane surfaces, always support the devices and connections.

1. Use an open-end wrench to prevent the device body from turning.
2. Use another wrench to loosen the connector nut.
3. Complete the disconnection by hand, turning *only* the connector nut.

CAUTION

Do *not* twist one connector out of the other, (like removing a light bulb). Turn the connector nut, not the device body. Major damage to the center conductor and the outer conductor can occur if the device body is twisted.

4. Pull the connectors straight apart without twisting or bending.

Handling and Storage

- Store the adapters with end caps on, in a foam-lined storage case.
- Never store adapters loose in a box, in a desk, or in a bench drawer. This is the most common cause of connector damage during storage.
- Keep connectors clean.
- Do not touch mating plane surfaces. Natural skin oils and microscopic particles of dirt are easily transferred to the connector interface and are very difficult to remove.
- Do not set connectors contact-end down on a hard surface. The plating and the mating plane surfaces can be damaged if the interface comes in contact with any hard surface.
- When you are not using a connector, use plastic end caps over the mating plane surfaces to keep them clean and protected.

4

Replaceable Parts

NOTE

There are no internal replaceable parts within the V281C/D and W281C/D adapters. The 1.0 mm connectors are not considered field reparable and are not listed. If a unit is in need of repair a replacement must be purchased.

The following table lists the part numbers necessary for inspection, ESD protection and replacement. To order a listed part, note the description, part number, and the quantity desired. Telephone or send your order to the nearest Agilent Technologies sales and service office (listed in [“Support and Service”](#) on page -v).

Table 4-1 Replaceable Parts

Description:	Part Numbers
Items Included With Adapters	
Operating and Service Manual	00281–90056
Waveguide Protective Cap (clear)	1401–0227
Coax Protective Cap (red)	1401–0202
Items Not Included With Adapters	
10X Magnifying Glass	1000–1114
6 mm 4 in-lb Torque Wrench	8710–2079
6 mm Open-end Wrench	8710–2156
Cleaning Swabs	9301–1243
Isopropyl Alcohol (30 ml)	--
Grounding Wrist Strap	9300–1367
5 Foot Grounding Cord (for wrist strap)	9300–0980
2 x 4 Foot Conductive Table Mat; 15 ft Ground Wire	9300–0797
ESD Heel Strap (for conductive floors)	9300–1308

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